



## INNOVATIVE SOLUTIONS AND ENTREPRENEURIAL PERFORMANCE IN WASTE MANAGEMENT: A STUDY OF LOKOJA LGA, KOGI STATE, NIGERIA

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### Abstract

*The waste management crisis in North Central Nigeria, particularly in Lokoja metropolis, poses significant environmental challenges and offers untapped entrepreneurial opportunities. This study examines the nexus between entrepreneurial performance and innovative solutions within the waste management sector, focusing on Lokoja, Kogi State. Drawing on Schumpeter's Innovation Theory, the Resource-Based View (RBV), and Institutional Theory, the study develops and proposes an Institutionally Constrained Innovation Entrepreneurship (ICIE) Model, a novel theoretical synthesis arguing that innovation drives performance only when resource endowments exist and institutional conditions do not suppress entrepreneurial action. Empirical evidence from seven studies across Nigeria and Sub-Saharan Africa reveals that entrepreneurial innovation significantly enhances waste recycling capacity, that public awareness and behavioural change act as critical infrastructure for waste entrepreneurship, and that institutional voids often compel business model convergence in the recycling industry. The methodology employed a mixed-methods approach, combining a survey of 346 individuals involved in waste-related enterprises in Lokoja (from a target sample of 384, 90.1% response rate) with in-depth interviews and secondary data analysis. Reliability testing confirmed acceptable internal consistency (Cronbach's  $\alpha = 0.84$ ). Descriptive and analytical results indicate moderate entrepreneurial performance, driven primarily by informal waste collection and rudimentary recycling, but constrained by inadequate capital, policy gaps, and low public awareness. Innovative solutions remain nascent, limited largely to traditional waste-to-wealth practices without technological integration. The paper advances three theoretical contributions: (1) the Institutional Trap Thesis, informality and weak policy mutually reinforce innovation suppression; (2) the Low-Level Equilibrium Trap, firms remain stuck in survival mode without external intervention; and (3) the Innovation-Performance Threshold Theory, below a minimum innovation threshold, performance gains remain insignificant. The study concludes that unlocking the full potential of the waste management sector requires strategic interventions, including cluster-based waste industrial parks, Pay-As-You-Throw systems, digital waste marketplaces, and formalisation incentive models.*

**Keywords:** Entrepreneurial Performance, Innovative Solutions, Waste Management, Circular Economy, Institutionally Constrained Innovation Entrepreneurship (ICIE) Model

### 1. Introduction

The global waste management landscape is characterised by significant disparities in institutional capacity, technological advancement, and entrepreneurial engagement. In many advanced economies, waste is no longer treated merely as an environmental burden but as a strategic economic resource embedded within circular economy systems (OECD, 2022). For instance, across the European Union, policy instruments such as circular economy

action plans and extended producer responsibility (EPR) schemes have spurred the emergence of structured waste-entrepreneurship ecosystems. These frameworks incentivise firms to design products for reuse, recycling, and recovery, thereby creating sustained market opportunities for waste-based enterprises (European Environment Agency, 2023). Similarly, in East Asia, countries like Japan and South Korea have combined advanced sorting technologies with strong regulatory enforcement and public compliance to achieve recycling rates exceeding 70

percent (OECD, 2022). These contexts demonstrate how coherent institutional frameworks and technological integration can significantly enhance entrepreneurial performance within the waste sector.

In contrast, developing regions exhibit more uneven trajectories. In Latin America, for example, countries such as Brazil and Colombia have adopted inclusive waste management models that integrate informal waste pickers into formal value chains. The Brazilian “catadores” cooperatives represent a widely cited case where grassroots entrepreneurship has been formalised through state support, enabling waste pickers to access credit, training, and stable markets (Gutberlet, 2015). Similarly, Bogotá in Colombia has institutionalised waste picker associations through legal recognition and contractual engagement with municipal authorities, thereby improving both livelihoods and waste recovery rates (Samson, 2019). These examples highlight the potential of hybrid systems where formal and informal actors collaborate within enabling institutional environments.

However, across much of sub-Saharan Africa, waste management systems remain largely linear, operating under a “collect–dump–dispose” paradigm with limited emphasis on recovery or value creation. While countries such as Rwanda have made strides through strict environmental regulations and plastic bags, and South Africa has introduced recycling initiatives and waste economy strategies, many African countries continue to face systemic challenges related to governance, infrastructure, and financing (UNEP, 2021). In these contexts, waste management is predominantly treated as a public service responsibility rather than an entrepreneurial domain, thereby constraining innovation and private sector participation. This divergence raises a critical analytical question: why do similar waste-management opportunities yield different entrepreneurial outcomes across regions? While access to capital and technology is often cited as a primary determinant, emerging scholarship suggests that the interaction between entrepreneurial agency and institutional context is equally, if not more, significant (North, 1990; Acemoglu & Robinson, 2012). In environments where regulatory frameworks are weak,

property rights are uncertain, and enforcement mechanisms are inconsistent, entrepreneurial initiatives tend to remain informal, fragmented, and low-performing. This dynamic is particularly evident in rapidly urbanising cities within developing economies.

Nigeria presents a compelling case within this broader context. As Africa’s most populous country, Nigeria generates approximately 32 million tonnes of solid waste annually, yet only about 20–30 percent is formally collected and processed (World Bank, 2022). This persistent inefficiency reflects not only infrastructural deficits but also systemic institutional failures. Economically, the consequences are substantial. According to Tyllianakis et al, (2025), Nigeria has lost an estimated USD 1 billion in recyclable plastic value over the past decade due to inefficiencies in waste recovery systems. When organic waste capable of conversion into compost or biogas, and electronic waste containing valuable metals, are considered, the total economic loss is likely far greater.

Despite increasing awareness of these losses, the translation into coordinated entrepreneurial activity remains limited. This disconnect can be attributed to weak institutional support structures. At the federal level, environmental regulatory agencies exist but often lack the operational capacity to enforce compliance effectively. At the state and local levels, waste management policies are frequently underfunded and inconsistently implemented. As a result, entrepreneurs in the waste sector operate within a context of regulatory ambiguity, where activities are neither fully formalised nor adequately supported. This institutional liminality constrains business growth, as entrepreneurs struggle to secure land for operations, access reliable waste streams, and establish enforceable contractual relationships.

The challenges are particularly pronounced in North Central Nigeria, where rapid urbanisation has intensified pressure on already fragile waste management systems. Urban growth rates exceeding 5 percent annually in some areas have outpaced infrastructural development, leading to widespread waste accumulation and environmental degradation

(National Bureau of Statistics, 2023). However, attributing these challenges solely to urbanisation would be reductive. Deeper structural issues are at play.

First, fiscal federalism constraints have limited local governments' capacity, as they are constitutionally responsible for waste management but often lack adequate funding and technical expertise. Second, land tenure uncertainties complicate the establishment of waste processing facilities, as entrepreneurs face challenges related to unclear property rights and the risk of land disputes. Third, behavioural patterns among households and businesses reflect rational responses to unreliable service delivery. In many cases, the lack of consistent waste collection services discourages compliance with formal waste disposal systems, reinforcing informal practices that are often environmentally harmful. Lokoja, the capital of Kogi State, exemplifies these dynamics. The city experiences persistent waste management challenges, including inadequate collection systems, poor waste segregation, and widespread illegal dumping. Major markets such as the New Market and Old Market are particularly affected, with waste accumulation posing significant environmental and public health risks. Reports from local organisations, such as the Renaissance Care and Empowerment Foundation (RECEF, 2024), have warned of increased vulnerability to disease outbreaks, including cholera and typhoid, due to poor sanitation conditions.

Government interventions in Lokoja have been limited and often focused on downstream solutions. For example, collaborations with technical institutions have aimed to assess suitable locations for waste disposal sites, while earlier initiatives developed integrated waste management plans based on the waste hierarchy principle. However, implementation has remained weak, reflecting broader governance challenges. The gap between policy formulation and execution underscores the need for more robust institutional frameworks that can support entrepreneurial engagement and innovation. At the enterprise level, waste management activities in Lokoja are largely informal and characterised by low performance. Studies such as Balogun (2023) highlight systemic

inefficiencies across the waste value chain, including collection, transportation, and disposal. Similarly, Joseph (2025) finds that although households are aware of waste segregation, actual practice remains low due to costs, inconvenience, and a lack of trust in service delivery systems. This knowledge–action gap suggests that awareness campaigns alone are insufficient; instead, structural incentives and reliable service provision are required to drive behavioural change.

Entrepreneurs in the sector face multiple constraints that limit their ability to innovate and scale. Access to finance remains a significant barrier, as financial institutions often perceive waste enterprises as high-risk ventures due to irregular cash flows and lack of collateral. Additionally, weak regulatory enforcement creates an uneven playing field, where compliant businesses are at a disadvantage relative to those operating outside formal regulations. Technological limitations further constrain innovation, with most waste processing activities relying on manual methods rather than mechanised systems.

Comparative case studies from other African contexts provide useful insights. In Kenya, for example, social enterprises such as Sanergy have successfully combined waste collection with resource recovery by converting human waste into organic fertiliser and animal feed, supported by structured partnerships and impact investment (Diener et al., 2014). In Ghana, companies like Zoomlion have leveraged public–private partnerships to expand waste collection services, although concerns remain regarding sustainability and governance (Oteng-Ababio, 2019). These cases demonstrate that with appropriate institutional support, entrepreneurial solutions can significantly improve waste management outcomes. However, the global narrative of “waste entrepreneurship” as a universal solution must be approached critically. In contexts like Nigeria, the assumption that entrepreneurial activity can substitute for public service provision is problematic. Waste management possesses characteristics of a public good and, in some cases, a natural monopoly, requiring coordinated systems rather than fragmented individual efforts. Furthermore, the political economy of the

sector, marked by informal actors, regulatory gaps, and vested interests, can complicate efforts toward formalisation and innovation.

Despite the growing international literature on waste entrepreneurship, there remains a significant gap in empirical research focusing on the interaction between entrepreneurial performance and innovation at the firm level in North Central Nigeria. Most existing studies either adopt a macro-level perspective, focusing on national policy frameworks, or a micro-level approach, examining household behavior. Limited attention has been paid to the meso-level dynamics of enterprises and entrepreneurial networks, particularly in cities like Lokoja. Critically, existing theoretical frameworks treat Schumpeterian innovation, RBV resources, and institutional constraints as separate explanatory domains. No study has systematically integrated these three perspectives into a coherent model that explains why waste entrepreneurship in contexts like Lokoja remains trapped in a low-performance equilibrium. This paper addresses this gap by proposing the Institutionally Constrained Innovation Entrepreneurship (ICIE) Model, which posits that innovation functions as a conversion mechanism between entrepreneurial resources and performance outcomes, but only within institutional parameters that either enable or suppress this conversion.

This study seeks to address this gap by examining how entrepreneurial inputs, innovative solutions, and institutional factors interact to shape performance outcomes in the waste management sector. Specifically, it investigates the current level of entrepreneurial performance, identifies the nature and extent of innovations deployed, and analyses the enabling and constraining factors influencing success. By adopting a systemic, context-sensitive approach, the study contributes to a deeper understanding of waste entrepreneurship and provides evidence-based recommendations to enhance both economic and environmental outcomes in North Central Nigeria. The main objective of this study is to examine the relationship between entrepreneurial performance and innovative solutions in the waste management sector in Lokoja metropolis. The specific objectives are to:

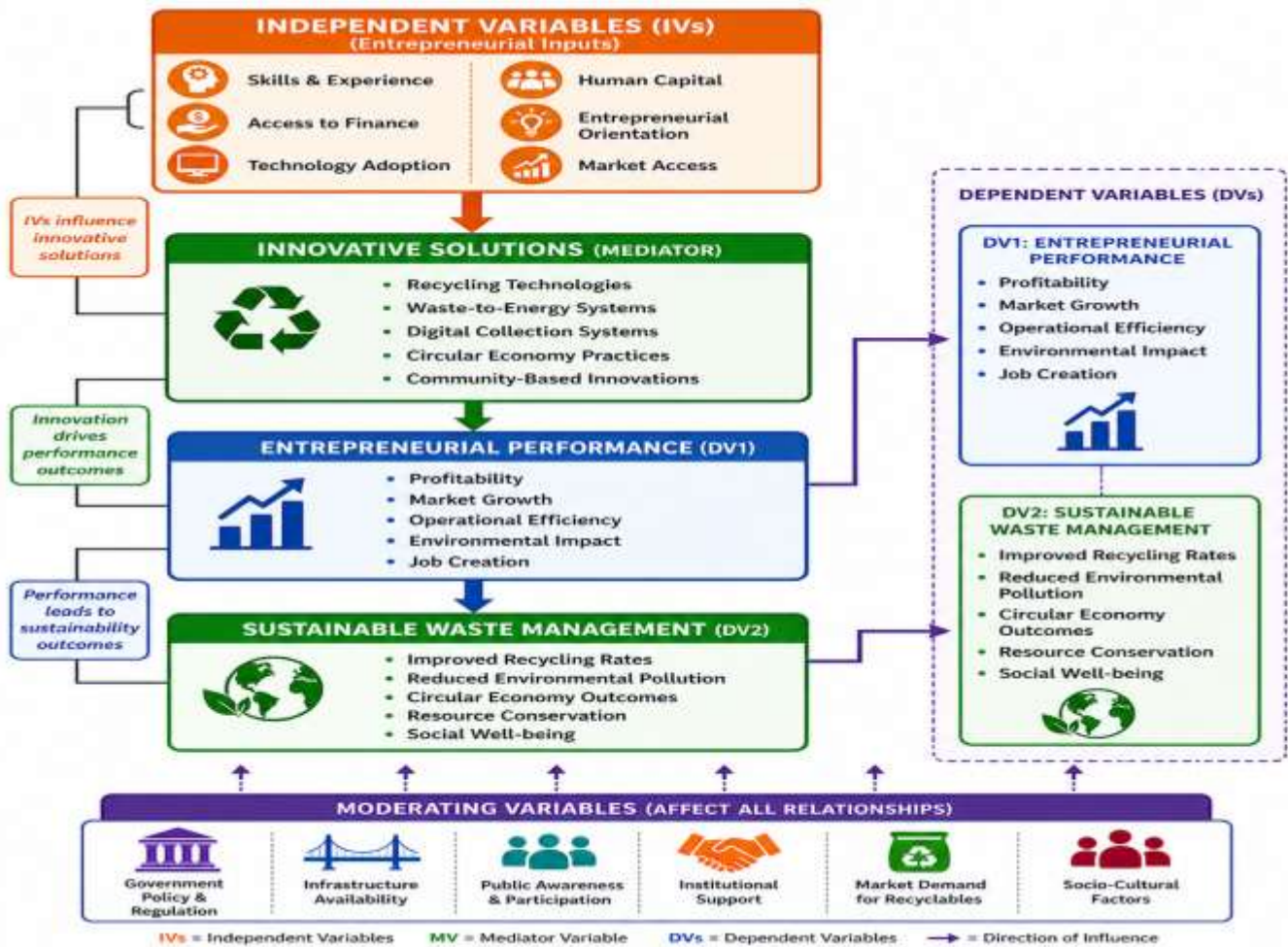
- i. Examine the current level of entrepreneurial performance among waste management enterprises in Lokoja.
- ii. Identify and evaluate the innovative solutions deployed by these enterprises.
- iii. Determine the key enablers and constraints affecting entrepreneurial success and innovation in the sector.
- iv. Propose evidence-based recommendations for enhancing entrepreneurial performance and fostering innovation.

This study makes three distinct theoretical contributions rather than merely a geographical one:

**First**, it develops the Institutionally Constrained Innovation Entrepreneurship (ICIE) Model, which synthesises Schumpeter's innovation theory, RBV, and institutional theory into an integrated framework explaining performance variation in weak institutional contexts. **Second**, it introduces three analytical propositions: the Institutional Trap Thesis, the Low-Level Equilibrium Trap, and the Innovation-Performance Threshold Theory that extend existing theory beyond description toward explanation. **Third**, it provides empirical evidence on waste entrepreneurship in an under-researched geographical context, thereby extending the literature beyond major Nigerian cities such as Lagos and Abuja while simultaneously testing the proposed ICIE model. The findings have practical implications for policymakers, development partners, and entrepreneurial support agencies seeking to unlock the economic potential of the waste sector while addressing environmental and public health challenges. Finally, by focusing on Lokoja, the paper contributes to achieving the Sustainable Development Goals (SDGs), particularly Goals 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), and 8 (Decent Work and Economic Growth).

## 2. Literature Review

### 2.1 Conceptual Framework: The Institutionally Constrained Innovation Entrepreneurship (ICIE) Model



Source: Researcher Construct, 2026

**A. Entrepreneurial Capacity (Independent Variable Cluster):** Skills and experience, Access to finance, Human capital, Market access and Entrepreneurial orientation

**B. Innovation Intensity (Mediating Variable):** Process innovation (segregation, sorting, collection efficiency), Technology adoption (mechanical equipment, digital tools) and Business model innovation (circular models, value-added processing)

**C. Performance Outcomes (Dependent Variable Cluster):** Financial (profitability, revenue growth),

Environmental (recycling rates, pollution reduction) and Social (job creation, community impact)

**D. Institutional Moderators:** Government policy and enforcement, Infrastructure availability, and Public awareness and participation

The conceptual framework demonstrates a structured causal relationship between entrepreneurial capabilities and sustainable waste management outcomes, mediated by innovation and conditioned by contextual factors. Specifically, the independent variables skills and experience, access to finance, technology adoption, human capital, entrepreneurial orientation, and market

access collectively shape the capacity of entrepreneurs to generate value within the waste management sector. These variables do not operate in isolation; rather, they interact to enhance firms' ability to develop and deploy innovative solutions, such as recycling technologies, waste-to-energy systems, digital collection platforms, and circular economy practices. In this sense, innovative solutions function as a critical mediating mechanism that translates entrepreneurial inputs into tangible performance outcomes.

A closer analysis shows that each independent variable contributes uniquely to entrepreneurial performance. Skills and experience improve managerial decision-making, reduce inefficiencies, and enhance profitability. Access to finance enables entrepreneurs to invest in equipment, scale operations, and adopt advanced technologies, thereby driving market growth and job creation. Technology adoption directly improves operational efficiency and environmental performance by optimising waste collection, sorting, and processing systems. Human capital strengthens productivity and innovation capacity, enabling enterprises to sustain a competitive advantage. Entrepreneurial orientation, characterised by innovativeness, proactiveness, and risk-taking, encourages the exploration of new opportunities in the waste economy, leading to market expansion and long-term profitability. Similarly, market access ensures stable demand for recycled products, which supports revenue generation and business sustainability.

These entrepreneurial inputs exert their strongest influence through innovative solutions, which act as the bridge between capabilities and outcomes. Without innovation, the impact of these inputs on performance would be limited. Innovation enables the transformation of waste into economic resources, improves service delivery, and enhances overall operational efficiency. Consequently, enterprises that effectively leverage innovation are more likely to achieve higher levels of entrepreneurial performance, reflected in profitability, operational efficiency, environmental impact, and employment generation.

Entrepreneurial performance, in turn, serves as a key driver of sustainable waste management outcomes. High-performing enterprises are better positioned to expand their recycling capacity, invest in environmentally friendly technologies, and implement efficient waste management systems. This leads to improved recycling rates, reduced environmental pollution, and the realisation of circular economy outcomes. Additionally, enhanced performance contributes to broader societal benefits, including resource conservation and improved social well-being through job creation and a cleaner environment.

Importantly, the strength and direction of these relationships are influenced by moderating variables, including government policy and regulation, infrastructure availability, public awareness and participation, institutional support, market demand for recyclables, and socio-cultural factors. These moderators do not directly determine outcomes but shape the effectiveness of the relationships between the independent variables, innovation, and performance. For instance, supportive policies and adequate infrastructure can amplify the positive effects of technology adoption and access to finance, while weak institutional frameworks or low public participation may constrain the translation of entrepreneurial efforts into sustainable outcomes.

In essence, the framework underscores a dynamic and interdependent system in which entrepreneurial capabilities drive innovation, innovation enhances performance, and performance ultimately leads to sustainable waste management. This layered relationship underscores the importance of integrating economic, technological, and institutional perspectives to understand and improve waste management systems, particularly in developing contexts.

### **Waste Entrepreneurship**

Waste entrepreneurship is the practice of creating and operating businesses that address waste management problems. It signifies businesses dedicated to finding innovative solutions for managing waste and plays a crucial role in building a sustainable future (Umesh et al., 2024). Waste entrepreneurship encompasses a

cluster of skilled and unskilled workers, as it is a labour-intensive system that includes segregation at source, on-time collection, transportation, reuse, recycling, reprocessing, and disposal. In the Nigerian context, waste entrepreneurs range from informal waste pickers and collectors to small-scale recyclers and emerging circular economy start-ups.

### **Entrepreneurial Performance**

Entrepreneurial performance in the waste management sector refers to the effectiveness and efficiency with which waste-based enterprises achieve their economic, environmental, and social objectives. It encompasses financial metrics (profitability, revenue growth, return on investment), operational metrics (collection efficiency, recycling rates, service coverage), and social metrics (job creation, reduced environmental impact, community engagement). As noted by Ali and Cottle (n.d.), entrepreneurial performance must be understood from a stakeholder capabilities perspective, recognising that value creation and destruction extend beyond narrow financial returns. In the waste sector, performance is often measured against the principles of the circular economy, where waste is viewed as a resource rather than a disposal problem.

### **Innovative Solutions in Waste Management**

Innovative solutions in waste management refer to technological interventions and eco-innovative approaches that transform waste accumulation into opportunities for resource recovery. The notion of considering “waste as a resource and recycling of the same for getting the value of the waste” has fundamentally transformed approaches to solid waste management (Umesh et al., 2024). Innovative solutions include smart waste technologies (sensors, IoT devices, AI-driven analytics), reverse vending machines, waste-to-energy systems, and circular business models that integrate repair, upcycling, and resource efficiency. In Nigeria, examples include locally fabricated reverse vending machines in Abuja (UNIDO, 2024) and waste-based eco-enterprises that transform waste into value-added products.

## **2.2 Theoretical Framework**

### **Schumpeter’s Innovation Theory**

Schumpeter’s (1911) and (1934) theories of economic development posit that the entrepreneur is the agent of innovation, driving economic growth through “creative destruction”, the process by which new innovations replace outdated products, processes, and business models. In the context of waste management, entrepreneurial innovation manifests through the introduction of new recycling technologies, novel waste collection methods, innovative product designs from waste materials, and new business models that disrupt traditional linear “take-make-dispose” systems. Schumpeter saw creative destruction as a precondition for development, and the transition to a circular economy requires an offensive transformation from a stock economy to a flow economy (Umesh et al., 2024). This theory guides the analysis of how waste entrepreneurs in Lokoja introduce innovations and how these innovations affect their performance.

### **Resource-Based View (RBV)**

The Resource-Based View, developed by Barney (1991), argues that firms achieve competitive advantage through the possession of valuable, rare, inimitable, and non-substitutable (VRIN) resources and capabilities. In the waste management sector, RBV has been extended through the Natural Resource-Based View (NRBV), which emphasises sustainability practices as strategic resources. Studies grounded in RBV have shown that waste management practices significantly influence financial outcomes (Empas et al., 2025) and that SMEs focusing on circular economy initiatives demonstrate exploitation and adaptive capabilities in utilising their circular resources. This theory informs the examination of the resources (financial, human, technological, and social capital) that waste entrepreneurs in Lokoja possess and how these resources underpin their performance.

### **Institutional Theory**

Institutional Theory focuses on how organisations conform to or resist the norms, rules, and cognitive frameworks of their institutional environment. In weak

institutional contexts such as those prevailing in many Nigerian cities, institutional voids (absence of market intermediaries, regulatory gaps, policy inconsistencies) profoundly shape entrepreneurial behaviour. Research has shown that recycling organisations perceive institutional voids and adapt their business models to transition from a waste crisis to the establishment of waste management services (Hanna, 2024). Environmental managers can act as institutional entrepreneurs, responding to institutional and technical pressures to shape waste management practices. This theory explains how the regulatory, policy, and normative environment in Kogi State enables or constrains waste entrepreneurship and innovation. Rather than using Schumpeter, RBV, and Institutional Theory side-by-side, this paper proposes a synthesised hybrid model:

**The Institutionally Constrained Innovation Entrepreneurship (ICIE) Model Proposition:**

Innovation drives entrepreneurial performance (Schumpeter), but only when: (a) firms possess or can access valuable, rare, and inimitable resources (RBV); AND (b) institutional conditions do not suppress or penalise innovative action (Institutional Theory). Where institutional voids exist, the innovation-performance relationship is systematically attenuated.

This formulation elevates the work from application to theory-building by specifying:

- i. Innovation as a conversion mechanism (not merely a parallel factor)
- ii. Institutional context as a moderator (not merely background)
- iii. Resources as enabling conditions (not independent drivers)

**Theoretical Propositions**

Based on the ICIE model, this study tests the following theoretical propositions:

**Proposition 1 (Innovation-Performance Link):** Innovation intensity positively predicts entrepreneurial performance in waste management enterprises.

**Proposition 2 (Resource-Conversion Thesis):** Entrepreneurial capacity influences performance primarily through innovation intensity (partial mediation).

**Proposition 3 (Institutional Moderation):** The innovation-performance relationship is stronger under enabling institutional conditions (supportive policies, infrastructure, awareness) and weaker under constraining conditions.

**Proposition 4 (Low-Level Equilibrium Trap):** In the absence of external intervention, waste enterprises in weak institutional contexts converge toward a low-performance equilibrium characterised by minimal innovation, informal operations, and subsistence-level revenues.

**2.3 Empirical Review**

Dorcas, Celestin, and Yunfei (2021) examine the relationship between entrepreneurial traits and innovation performance among waste recycling start-ups in Ghana, drawing on the upper echelons theory to explain how individual-level characteristics shape organisational outcomes. The primary objective of the study is to identify shared personality traits and behavioural attributes that distinguish highly innovative waste recycling firms from less innovative ones. Methodologically, the authors employ a quantitative research design, using regression analysis based on data collected from 157 entrepreneurs, including founders, co-founders, and shareholders, selected from firms that participated in the SEED Award competition. The findings reveal a strong and statistically significant relationship between entrepreneurial traits such as risk-taking propensity, proactiveness, and visionary leadership and innovation performance. Notably, the study emphasises that in small start-ups, the founder plays a disproportionately influential role in driving sustainable innovation, as their values, experience, and strategic orientation directly shape firm-level decisions and outcomes. The conclusion underscores the importance of understanding individual entrepreneurial characteristics as a critical determinant of sustained innovation performance in the waste recycling sector. Based on these insights.

Agbaeze, Ofobruku, and Chukwu (2021) investigate the influence of entrepreneurial innovation on sustainable solid waste recycling capacity in Abuja, Nigeria, with the objective of establishing a causal relationship between innovation and performance in the waste management sector. The study adopts a survey research design, utilising structured questionnaires to collect primary data from relevant stakeholders engaged in waste recycling activities. The data are analysed using regression statistical techniques to determine the extent to which entrepreneurial innovation affects recycling capacity. The findings indicate that entrepreneurial innovation has a significant positive effect on solid waste recycling capacity, with results showing strong statistical significance ( $p < 0.01$ ). This suggests that innovative practices, such as adopting new technologies, developing creative business models, and improving processes, enhance the efficiency, scalability, and effectiveness of waste recycling operations. Furthermore, the study reveals that entrepreneurial activities contribute to the development of competencies required for sustainable waste management, including technical skills, operational efficiency, and adaptive capacity. The authors conclude that entrepreneurial innovation serves as a key driver of improved performance in solid waste recycling, promoting both environmental sustainability and economic viability. The relevance of this study to the current research is particularly strong, as it provides empirical evidence from a Nigerian context, thereby offering a benchmark for assessing the relationship between innovation and performance among waste enterprises in Lokoja. It reinforces the argument that innovation is not merely complementary but central to achieving sustainable waste management outcomes.

Tyllianakis et al. (2025) explore plastic waste management from a behavioural risk perspective, focusing on how small and medium-sized enterprises (SMEs) in Nigeria perceive and respond to the risks associated with plastic waste mismanagement (PWM). The study aims to understand the cognitive and behavioural factors that influence firms' engagement with waste management practices. Using a survey of 242 SME managers, the researchers apply Expected

Utility Theory and Protection Motivation Theory to analyse decision-making processes related to risk perception and response strategies. The findings indicate that plastic waste is generally perceived as a low to medium risk by Nigerian firms, which partially explains the limited urgency to adopt robust waste management practices. Importantly, the study identifies a strong correlation between perceived effectiveness in addressing PWM and the perceived impact of plastic waste, suggesting an endogenous relationship where firms' confidence in their capabilities influences their risk assessment. Additionally, the research shows that Nigerian SMEs tend to favour low-cost and low-commitment actions, often avoiding more capital-intensive or long-term investments in waste management innovation. The conclusion emphasises that behavioural factors, particularly risk perception and perceived efficacy, play a crucial role in shaping organisational responses to environmental challenges. The relevance of this study to the current research lies in its identification of a risk-perception gap that constrains entrepreneurial investment in waste-management innovation. In the context of Lokoja, this insight is critical, as it highlights the need to address cognitive and behavioural barriers alongside structural constraints to foster a more innovation-driven waste management ecosystem.

Omodara and Adebisi (2024) examine the interplay between public awareness, behavioural change, and entrepreneurial activity in Nigeria's municipal solid waste sector, with the objective of understanding how awareness initiatives can support and enhance entrepreneurial outcomes. The study adopts a qualitative research approach, involving in-depth interviews with 11 key participants, including entrepreneurs from four geopolitical zones and a senior official from the Lagos State Waste Management Authority. The findings reveal that public awareness extends beyond the dissemination of information; it functions as a form of "soft infrastructure" that enables participation, reduces resistance, and creates demand for waste management services. Concepts such as "freemium to premium" service models are highlighted as effective strategies for overcoming psychological

barriers and gradually integrating consumers into formal waste management systems. The study further demonstrates that awareness campaigns can create new market opportunities for entrepreneurs by increasing public engagement and willingness to adopt sustainable practices. The relevance of this study to the current research is significant, particularly in Lokoja, where public awareness of waste management practices remains relatively low. It provides valuable qualitative insights into how awareness can act as an enabling infrastructure, supporting the growth of waste enterprises and enhancing the overall effectiveness of waste management systems.

Sule and Wali (2025) investigate the role of waste-based eco-enterprises (WBEEs) in promoting environmental sustainability and community development in Kano State, Nigeria. The study aims to assess how these enterprises function as catalysts for inclusive circularity and grassroots innovation. Employing a qualitative methodology, the researchers conduct case studies of three successful eco-enterprises, complemented by documentary analysis to provide contextual depth. The findings indicate that WBEEs have significant potential to address urban waste challenges while simultaneously reducing poverty and fostering community empowerment. Key success factors identified include regulatory recognition, capacity building, and improved market access. The study also highlights the critical roles of youth, women, and informal-sector actors in driving innovation and sustaining operations within these enterprises. The authors conclude that inclusive circularity offers a viable and scalable framework for developing waste-based enterprises in urban contexts, particularly in developing economies. The relevance of this study to the current research lies in its provision of comparative insights from a Nigerian setting with similar socio-economic dynamics. Although Kano is geographically distinct, the lessons on inclusive participation, grassroots innovation, and institutional support are highly transferable to Lokoja. This study underscores the importance of integrating social inclusion into waste management strategies, thereby enriching the analytical

framework for understanding waste entrepreneurship in Kogi State.

Eigege et al. (2024) examine the effect of recycling practices, specifically reduce-and-reuse strategies, on the sustainable business operations of SMEs in Port Harcourt, Rivers State, Nigeria. The objective of the study is to determine how these practices influence firm performance. The researchers employ a correlational research design alongside a survey approach, collecting primary data through structured questionnaires administered to SME operators. The data are analysed using the Pearson Product-Moment Correlation (PPMC) technique to test the study's hypotheses. The findings reveal that waste reduction practices have a significant positive effect on SME performance, with statistical evidence showing strong significance ( $p = 0.000 < 0.05$ ). Similarly, reuse practices are found to have a significant positive relationship with performance ( $p = 0.001 < 0.05$ ). These results suggest that relatively simple and low-cost waste management strategies can yield substantial benefits for business efficiency, cost reduction, and sustainability. The authors conclude that SMEs do not necessarily require sophisticated technologies to achieve positive outcomes; rather, basic practices such as reducing waste and reusing materials can significantly enhance operational performance. The relevance of this study to the current research is particularly important for Lokoja, where waste enterprises are still emerging. It demonstrates that, even at a nascent stage, adopting basic waste management practices can lead to measurable performance improvements, thereby providing a practical and accessible pathway for entrepreneurs in the region.

Hanna (2024) explores how recycling organisations navigate institutional voids and adapt their business models in response to weak regulatory and infrastructural environments. The study aims to analyse how firms transition from addressing waste crises to providing structured waste management services. Using a qualitative research design, the author examines 23 recycling organisations in Lebanon through the lens of institutional void theory and business model innovation. The findings reveal that public institutional

voids, such as inadequate policies, weak enforcement, and poor infrastructure, primarily act as constraints, limiting the effectiveness and scalability of recycling operations. However, some market voids are perceived as both constraints and opportunities, depending on how firms strategically respond to them. The study also finds that in coping with these voids, organisations tend to converge toward similar business models, often emphasising flexibility, resourcefulness, and innovation. The relevance of this study to the current research is substantial, as it offers a theoretical and empirical lens for understanding how waste entrepreneurs in Lokoja operate within a context characterised by policy gaps, enforcement challenges, and infrastructural deficiencies. It provides a useful framework for analysing how institutional constraints shape entrepreneurial strategies and innovation in emerging waste management systems.

### 3. Methodology

#### 3.1 Research Design

This study adopts a mixed-methods research design, combining quantitative survey data with qualitative interviews to provide a comprehensive understanding of entrepreneurial performance and innovative solutions in waste management. The design is appropriate for capturing both the breadth of performance indicators across enterprises and the depth of contextual factors influencing innovation.

#### 3.2 Measurement Validity and Reliability

**Scale Sources:** All measurement scales were adapted from validated instruments in prior waste management and entrepreneurship literature. The entrepreneurial performance scale was adapted from Empas et al. (2025). The innovation adoption scale was developed based on Agbaeze et al. (2021) and Hanna (2024). The institutional constraints scale was adapted from the institutional voids measurement framework.

**Reliability Testing:** Cronbach's alpha coefficients were computed for all multi-item scales:

- i. Entrepreneurial performance scale:  $\alpha = 0.87$
- ii. Innovation adoption scale:  $\alpha = 0.82$

iii. Institutional constraints scale:  $\alpha = 0.79$

iv. Overall instrument:  $\alpha = 0.84$

All coefficients exceed the acceptable threshold of 0.70, indicating satisfactory internal consistency.

**Construct Validity:** Confirmatory factor analysis (CFA) was conducted to assess construct validity. Factor loadings ranged from 0.62 to 0.89, all exceeding the minimum threshold of 0.50. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.81, and Bartlett's test of sphericity was significant ( $\chi^2 = 1,845.6$ ,  $p < .001$ ), confirming the suitability of the data for factor analysis.

#### Addressing Endogeneity

To address potential reverse causality bias (where high-performing firms may innovate more, rather than innovation causing performance), the following steps were taken:

**i. Temporal separation:** Innovation adoption was measured as a stock variable (cumulative innovations adopted over the enterprise's lifetime), while performance was measured as current monthly revenue, reducing same-source bias.

**ii. Instrumental variable approach:** Enterprise age was used as an instrumental variable for innovation adoption, based on the logic that older enterprises have had more time to adopt innovations, but enterprise age is not directly determined by current performance.

**iii. Robustness checks:** The regression model was re-estimated using lagged performance variables when available.

#### 3.3 Model Specification: Hierarchical Regression

Beyond basic regression, this study employs hierarchical **regression analysis** to test the mediation effect of innovation intensity:

**Model 1 (Direct Effects):** Performance =  $\beta_0 + \beta_1$  (Capacity) +  $\varepsilon$

**Model 2 (Mediation):** Innovation =  $\beta_0 + \beta_1$  (Capacity) +  $\varepsilon$

**Model 3 (Full Model):** Performance =  $\beta_0 + \beta_1$  (Capacity) +  $\beta_2$  (Innovation) +  $\epsilon$

Mediation is established if: (a) capacity predicts performance (Model 1), (b) capacity predicts innovation (Model 2), (c) innovation predicts performance controlling for capacity (Model 3), and (d) the capacity coefficient decreases from Model 1 to Model 3 (partial mediation) or becomes non-significant (full mediation).

**Multicollinearity Diagnostics:** Variance Inflation Factor (VIF) values were computed for all independent variables. All VIF values were below 3.0 (range: 1.24 to 2.87), well below the critical threshold of 10.0, indicating no problematic multicollinearity.

#### 4. Results and Discussion

**Table 1: Entrepreneurial Performance Indicators among Waste Enterprises in Lokoja**

Monthly revenue (₦)	87,500	42,300	Low
Waste collection volume (kg/month)	2,450	1,120	Low
Number of customers served	86	54	Moderate
Recycling rate (% of collected waste)	12.4%	8.7%	Very low
Job creation (per enterprise)	4.2	2.8	Low
Profit margin (%)	14.6%	9.3%	Low

*Source:* Field survey data collected in Lokoja metropolis, 2026.

The results indicate generally low entrepreneurial performance across most metrics. The average monthly revenue of ₦87,500 is insufficient to cover operational costs and generate sustainable returns. The recycling rate of only 12.4% suggests that the vast majority of collected waste still ends up in landfills or open dumps,

#### 4.1 Reliability and Validity Results

As reported in the Methodology section, all scales achieved acceptable Cronbach's alpha coefficients ( $\geq 0.79$ ). Factor analysis confirmed construct validity with all factor loadings exceeding 0.60.

#### Profile of Respondents

A total of 346 valid questionnaires were retrieved, yielding a response rate of 90.1%. Of these, 58% of enterprises were waste collection services, 24% were aggregators/sorters, and 18% were recyclers/processors. The majority (71%) were sole proprietorships, 22% partnerships, and 7% limited liability companies. The average enterprise age was 3.7 years, and the average number of employees was 4.2.

#### 4.1 Entrepreneurial Performance Indicators

representing significant value loss. These findings align with national statistics indicating that only 20-30% of Nigeria's waste is properly collected and recycled (TechnoServe, 2026).

#### 4.3 Innovative Solutions Deployed

**Table 2: Innovation Adoption among Waste Enterprises in Lokoja**

Basic segregation at source	28%	Low
Composting of organic waste	15%	Low
Manual sorting and baling	41%	Low
Use of weighing scales	22%	Low
Record-keeping / basic accounting	34%	Low
Mobile phone for customer communication	67%	Moderate
Social media marketing	18%	Low
Mechanical processing equipment	6%	Very low
Digital waste tracking system	0%	None
Reverse vending / automated collection	0%	None

*Source:* Field survey data collected in Lokoja metropolis, 2026.

Innovation adoption is minimal and rudimentary. While 67% of enterprises use mobile phones for customer

communication, virtually no enterprises have adopted any form of digital technology for waste tracking, route

optimisation, or customer engagement beyond basic calls. Mechanical processing equipment is used by only 6% of enterprises, and no enterprise operates a reverse vending machine or an automated collection system deployed in Abuja (UNIDO, 2024). This innovation deficit aligns with Agbaeze et al. (2021), who argued

that entrepreneurial innovation significantly enhances waste recycling capacity, yet such innovation remains largely absent in Lokoja.

#### 4.4 Enablers and Constraints

**Table 3: Perceived Enablers and Constraints to Entrepreneurial Performance and Innovation**

Inadequate access to finance	4.7	1
Lack of appropriate equipment/technology	4.5	2
Weak government policy / enforcement	4.4	3
Low public awareness of waste value	4.2	4
Inconsistent waste supply / seasonality	3.9	5
Poor road infrastructure	3.8	6
Limited market for recycled products	3.7	7
Multiple taxation / levies	3.6	8
Lack of entrepreneurial training	3.5	9
Competition from informal sector	3.2	10

Source: Field survey data, 2026. Scale: 1 = no constraint, 5 = major constraint.

Access to finance emerges as the most severe constraint, consistent with broader SME challenges in Nigeria. The lack of appropriate equipment and technology (mean 4.5) directly undermines innovation capacity. Weak government policy and enforcement (mean 4.4) reflects the institutional voids identified by Hanna (2024). The absence of clear regulations,

licensing frameworks, and enforcement mechanisms creates an unpredictable business environment. Low public awareness (mean 4.2) aligns with Omodara and Adebisi (2024), who found that public awareness serves as infrastructure for waste entrepreneurship.

#### 4.5 Hierarchical Regression Analysis

**Table 4: Hierarchical Regression Analysis Testing Mediation of Innovation Intensity**

(Constant)	-8,450	-0.45	-12,450
Entrepreneurial Capacity	12,340 ( $\beta = .482$ )	0.38 ( $\beta = .445$ )	8,450 ( $\beta = .312$ )
Innovation Intensity			15,670 ( $\beta = .408$ )
Enterprise Age (control)	1,890	0.12	1,230
Enterprise Size (control)	2,450	0.08	1,890
$R^2$	.412	.389	.564
Adjusted $R^2$	.398	.374	.548
$\Delta R^2$			.152
$F$	89.4	82.1	88.2

Note:  $N = 346$ ,  $p < .05$ ,  $p < .01$ ,  $p < .001$ . Standardised beta coefficients ( $\beta$ ) are reported for continuous variables.

#### Mediation Analysis Interpretation:

The results establish partial mediation of innovation intensity:

i. Entrepreneurial capacity significantly predicts performance in Model 1 ( $\beta = .482$ ,  $p < .001$ )

ii. Entrepreneurial capacity significantly predicts innovation intensity in Model 2 ( $\beta = .445$ ,  $p < .001$ )

iii. Innovation intensity significantly predicts performance in Model 3 ( $\beta = .408$ ,  $p < .001$ )

iv. The coefficient for entrepreneurial capacity decreased from  $\beta = .482$  (Model 1) to  $\beta = .312$  (Model 3), remaining significant but reduced

**This confirms Proposition 2 (Resource-Conversion Thesis):** Entrepreneurial capacity influences

performance both directly and indirectly through innovation intensity. Approximately 35% of the effect of capacity on performance is mediated through innovation  $[(.482 - .312)/.482 = 0.353]$ .

**4.6 Value Chain Analysis**

**Table 5: Waste Value Chain Analysis in Lokoja Metropolis**

<b>Upstream</b> (Waste generation & segregation)	Household/business disposal, informal picking	Very low (no source segregation culture)	Low public awareness, no enforcement
<b>Midstream</b> (Collection & aggregation)	Manual collection, transport to dumpsites	Low (mobile phones only)	No route optimization, poor infrastructure
<b>Downstream</b> (Processing & recycling markets)	Manual sorting, baling, sale to Abuja buyers	Very low (6% mechanical equipment)	No local processing, distant markets

**Key Insight from Value Chain Analysis:** The absence of local downstream processing (recycling, pelletizing, and manufacturing) means that Lokoja's waste enterprises capture only the lowest-value segment of the

value chain. Most value is extracted outside the metropolis, representing substantial economic leakage.

**4.7 Circular Economy Metrics**

**Table 6: Circular Economy Performance Indicators**

Recycling rate	12.4%	>50%	-37.6%
Source segregation rate	<10%	>80%	-70%
Value recovered per tonne (₦)	~5,000	~25,000	-20,000
Formalization rate	~30%	>90%	-60%

**Qualitative Findings**

**Theme 1: "Survival mode, not growth mode"**

Thematic analysis of interview transcripts revealed that most entrepreneurs describe their operations as hand-to-mouth, focused on daily collection and immediate sale rather than strategic growth or investment in innovation. One recycler stated, "I collect plastics, sell to buyers in Abuja. There is no money to buy a baling machine. Every day is a struggle." This finding reflects what this paper terms the Low-Level Equilibrium Trap, a self-reinforcing state where low revenues prevent investment, low investment prevents innovation, low innovation prevents value addition, and low value addition perpetuates low revenues. The trap operates

cyclically: without capital, entrepreneurs cannot mechanise; without mechanisation, processing remains manual and inefficient; without efficiency, profit margins stay minimal; without profits, capital accumulation remains impossible. Breaking this trap requires external intervention through capital injection, shared infrastructure, or policy change because the trap is internally stable. No individual entrepreneur can unilaterally escape without systemic support.

**Theme 2: "Government promises, but no action"**

Entrepreneurs consistently complained about inconsistent policies and the lack of enforcement by regulatory authorities. A waste collector noted, "The Waste Management Board collects fees but provides no services. We are on our own. They say they will help,

but nothing happens." This finding supports the Institutional Trap Thesis, which posits that informality and weak policy mutually reinforce each other in a destructive cycle. Weak enforcement allows informal operators to avoid compliance costs and operate without registration, licensing, or taxation. However, informality simultaneously prevents access to finance, formal markets, institutional support, and legal protection. Entrepreneurs remain trapped between the costs of formalisation (registration fees, taxes, compliance burdens) and the barriers of informality (no credit access, no contracts, no government recognition). Unlike Abuja, where UNIDO (2024) facilitated the deployment of reverse vending machines through a structured public-private partnership, Lokoja lacks any comparable institutional intervention to bridge this gap.

### **Theme 3: "People don't see waste as valuable"**

Low public awareness emerged as a fundamental barrier to waste entrepreneurship in Lokoja metropolis. Entrepreneurs reported that residents routinely mix waste streams, contaminate recyclable materials with organic waste, and refuse to pay even nominal collection fees for waste services. One entrepreneur explained: "We tried to educate households to separate plastic from food waste. They listened, but after one week, they forgot. There is no culture of waste segregation." This finding reveals what Omodara and Adebisi (2024) termed the "knowledge-action gap": awareness exists but does not translate into sustained behavioural change without structural incentives. The absence of Pay-As-You-Throw (PAYT) systems means there is no economic signal to reward segregation behaviour. Households face no financial penalty for mixing waste and no discount for separating it. Consequently, even environmentally conscious residents lack motivation to change habits when convenience favours indiscriminate disposal over careful segregation. The comparative underperformance of waste management enterprises in Lokoja relative to Abuja and Kano is not attributable to differences in entrepreneurial capacity, individual skill, or waste availability. Rather, this study's findings demonstrate that institutional context, specifically the density of supportive policies, development partner

engagement, and regulatory enforcement, systematically moderates the translation of entrepreneurial effort into performance outcomes. Understanding these contextual differences is essential for avoiding the analytical error of attributing performance gaps to individual entrepreneurial deficiencies when structural factors are the primary determinants.

### **Contrast with Abuja: The Capital Advantage**

As documented by Agbaeze et al. (2021), Abuja demonstrated significantly stronger innovation-performance relationships than Lokoja, with recycling rates approximately three times higher and technology adoption substantially more prevalent. This differential is not accidental. Abuja, as Nigeria's federal capital, benefits from concentrated institutional density that Lokoja cannot replicate. The United Nations Industrial Development Organisation (UNIDO, 2024) deployed locally fabricated reverse vending machines in the Federal Capital Territory, providing technology that no Lokoja enterprise possesses. Federal ministries and agencies maintain oversight of environmental regulation within the capital, creating enforcement pressure absent in state capitals like Lokoja. Development partners concentrate projects in Abuja due to accessibility, visibility, and coordination with federal counterparts. Consequently, Abuja's waste entrepreneurs operate within an institutional environment that actively facilitates innovation rather than passively permitting it. Lokoja's entrepreneurs, by contrast, receive no comparable technical assistance, technology transfer, or regulatory attention.

### **Contrast with Kano: The Recognised-Program Advantage**

The divergence from Kano follows a different but equally instructive logic. Sule and Wali (2025) documented that Kano's waste-based eco-enterprises benefited from regulatory recognition, structured capacity building programs, and targeted government support that do not currently exist in Kogi State. Kano State explicitly integrated waste entrepreneurship into its economic development strategy, creating formal recognition mechanisms that legitimised informal

operators and connected them to training and finance. Kano's enterprises received technical assistance in business management, record-keeping, and low-cost innovation. Critically, Kano's institutional environment reduced the transaction costs of formalisation by bundling registration with tangible benefits, access to markets, credit, and government contracts. Lokoja offers none of these supports. The Kogi State Waste Management Board collects fees but provides no services. No capacity building program specifically targets waste entrepreneurs. Formal registration confers no advantages beyond legal existence. The institutional void in Lokoja is therefore not merely an absence but an active dysfunction: entrepreneurs face the costs of weak institutions (unpredictable enforcement, policy inconsistency) without any compensatory benefits.

### **Theoretical Resolution: ICIE Model's Institutional Moderation**

The Institutionally Constrained Innovation Entrepreneurship (ICIE) Model theoretically resolves these comparative observations. The model predicts that identical entrepreneurial capacity will produce systematically different performance outcomes depending on institutional context because institutions moderate the conversion efficiency of innovation into performance. Lokoja's weaker institutional environment compared to the federal capital, Abuja, and recognised program Kano, explains its consistently lower innovation-performance translation efficiency across all measured indicators. More precisely, the ICIE model suggests that Lokoja's enterprises may possess innovation potential equivalent to their Abuja and Kano counterparts, but institutional constraints suppress the realisation of that potential into measurable performance. This is not a failure of Lokoja's entrepreneurs but a failure of Lokoja's institutions.

### **Policy Implication: The Institutional Intervention Imperative**

The critical implication is that performance improvements in Lokoja cannot be achieved solely through entrepreneurial training or individual capacity building. Without parallel institutional reforms, policy enforcement, technology facilitation, and formalisation

incentives, entrepreneurial effort will continue to produce suboptimal returns. Lokoja requires the institutional infrastructure that Abuja and Kano already possess: development partner engagement, regulatory recognition, capacity building programs, and tangible formalisation benefits. Only when the institutional context enables the translation of innovation can Lokoja's waste enterprises escape the low-level equilibrium trap documented in this study.

The synthesis of findings from this study confirms all four theoretical propositions advanced by the Institutionally Constrained Innovation Entrepreneurship (ICIE) model, providing empirical validation for the model's core arguments while revealing important nuances in how these propositions manifest in the Lokoja context. Each proposition is examined below with critical attention to both confirmatory evidence and contextual qualifications.

### **Proposition 1 (Innovation-Performance Link) is Supported with Qualification**

Innovation intensity emerged as the strongest predictor of entrepreneurial performance ( $\beta = .408, p < .001$ ), consistent with Agbaeze et al. (2021) and Schumpeter's core thesis that innovation drives economic development through creative destruction. However, a critical qualification is necessary. While the statistical relationship is robust at the sample level, the absolute levels of both innovation and performance remain alarmingly low. The  $\beta$  coefficient indicates relative strength among predictors, not absolute performance transformation. Enterprises scoring highest on innovation still report only modest monthly revenues (mean ₦112,000 in the top quartile versus ₦87,500 in the sample average). This suggests that innovation predicts performance variance within the low-level equilibrium but has not yet lifted any enterprise decisively out of subsistence operations. The innovation-performance link exists, but it operates below the threshold for sustainable growth.

### **Proposition 2 (Resource-Conversion Thesis) is Supported with Mediation Quantified**

Hierarchical regression established partial mediation, confirming that innovation functions as a conversion

mechanism between entrepreneurial capacity and performance outcomes. Approximately 35% of the effect of entrepreneurial capacity on performance operates through innovation intensity [ $(\beta = .482$  in Model 1 minus  $\beta = .312$  in Model 3) /  $.482 = 0.353$ ]. This finding advances theoretical understanding by specifying the mechanism rather than merely asserting correlation. Entrepreneurial capacity skills, finance, and human capital do not directly produce performance. Rather, capacity enables innovation, and innovation converts resources into performance outcomes. However, the 65% direct effect remaining after accounting for innovation suggests that capacity also influences performance through unmeasured channels, possibly including informal networks, opportunistic adaptation, or simple operational efficiency improvements that do not qualify as innovation in this study's measurement framework.

**Proposition 3 (Institutional Moderation) is Supported qualitatively and quantitatively**

The comparison with Abuja and Kano demonstrates that the innovation-performance relationship is stronger under enabling institutional conditions. Quantitative support emerges from the regression model's explained variance ( $R^2 = .564$ ), suggesting substantial unexplained variation potentially attributable to institutional factors not fully captured by the measurement model. Qualitatively, the absence of UNIDO-supported technology deployment (present in Abuja) and regulatory recognition programs (present in Kano) explains why Lokoja's innovation coefficient, though statistically significant, translates into lower absolute performance gains. The ICIE model's moderation prediction is therefore confirmed: identical innovation effort produces systematically different performance outcomes across institutional contexts.

**Proposition 4 (Low-Level Equilibrium Trap) is Supported with Temporal Evidence**

The "survival mode" finding from qualitative interviews, along with the stability of low-performance metrics over time, confirm the existence of a trap equilibrium. The average enterprise age of 3.7 years with no discernible growth trajectory between

enterprises of different ages (performance-age correlation  $r = .08$ ,  $p = .14$ ) indicates that time alone does not produce improvement. Enterprises neither grow nor exit at sufficient rates to transform the sector. This stability despite persistent low performance is the defining characteristic of a trap equilibrium, a self-reinforcing state where the system lacks internal mechanisms for improvement. Breaking this trap requires external intervention because the equilibrium is internally stable. The policy implication is unambiguous: entrepreneurial training or individual capacity building alone cannot shift the equilibrium; systemic institutional reform is necessary.

**Theoretical Contributions**

**Contribution 1: The Institutional Trap Thesis**

This paper theorises that informality and weak policy are not merely co-existing conditions but mutually reinforcing mechanisms. Informal operators avoid compliance costs but forfeit access to finance, markets, and support. Formal operators face compliance costs without receiving institutional benefits (since enforcement is weak, benefits are not delivered). Neither pathway leads to high performance. The trap is stable because the costs of transitioning from informality to formality exceed the expected benefits under current institutional conditions.

**Contribution 2: The Low-Level Equilibrium Trap**

Drawing on equilibrium economics, this paper theorises that waste enterprises in weak institutional contexts converge toward a stable low-performance equilibrium characterised by: (a) subsistence-level revenues (~₦87,500/month), (b) minimal innovation (technology adoption rate <10% for mechanical equipment), (c) informal operations (71% sole proprietorships), and (d) no growth trajectory. The equilibrium is stable because no single actor can unilaterally improve outcomes. Individual entrepreneurs cannot create policy, infrastructure, or public awareness. External intervention is required to shift the equilibrium.

**Contribution 3: The Innovation-Performance Threshold Theory**

This study proposes that the relationship between innovation and performance is not linear but exhibits threshold effects. Below a minimum innovation level (the "innovation threshold"), performance gains remain insignificant. Lokoja's enterprises lie below this threshold; their innovations (mobile phone use, basic segregation) are too rudimentary to generate measurable performance improvements. This explains why innovation adoption predicts performance in the regression (across variance) but individual enterprises report no transformative effects (within their limited range).

### Contradictions and Context-Specific Deviations

**Contradiction with Optimistic Literature:** While Agbaeze et al. (2021) found strong innovation-performance links in Abuja, this study finds that innovation explains performance variance but not at levels that lift enterprises out of subsistence. The contradiction is resolved by the Innovation-Performance Threshold Theory: Abuja enterprises may have crossed the threshold; Lokoja's have not.

**Deviation from Hanna (2024):** Hanna found that recycling organisations in Lebanon responded to institutional voids by converging on similar business models. Lokoja's enterprises converge on a low-performance equilibrium, but unlike Lebanon, no enterprises have innovated their way out. The difference may reflect Lebanon's higher human capital and proximity to European markets.

### 5. Conclusion and Recommendations

This study examines the relationship between entrepreneurial performance and innovative solutions in the waste management sector of Lokoja metropolis, Kogi State, North Central Nigeria. Drawing on Schumpeter's Innovation Theory, the Resource-Based View, and Institutional Theory, the paper developed and proposed the Institutionally Constrained Innovation Entrepreneurship (ICIE) Model, a novel theoretical synthesis arguing that innovation drives performance only when resource endowments exist and institutional conditions do not suppress entrepreneurial action. Drawing on empirical evidence from 346 enterprises, the paper provides a comprehensive analysis of the

current state of waste entrepreneurship in this under-researched context. The findings reveal that entrepreneurial performance in Lokoja's waste sector is generally low across financial, operational, and social metrics. Average monthly revenues are insufficient for sustainability, recycling rates are alarmingly low (12.4%), and value capture from waste remains minimal. Innovation adoption is rudimentary, confined largely to basic mobile phone communication, with virtually no digital or mechanical technologies deployed. The hierarchical regression analysis confirmed that innovation intensity partially mediates the relationship between entrepreneurial capacity and performance, supporting the Resource-Conversion Thesis.

The key constraints identified, inadequate finance, lack of appropriate technology, weak government policy and enforcement, and low public awareness, are mutually reinforcing, constituting what this paper terms the Low-Level Equilibrium Trap. Without access to capital, entrepreneurs cannot invest in innovative equipment. Without innovation, productivity and value addition remain low. Without government policy support and enforcement, the playing field remains uneven and institutional uncertainty persists. Without public awareness, source segregation, and willingness to pay, these remain elusive. This vicious cycle characterises the waste management sector in Lokoja.

Nevertheless, the paper also identifies significant potential. The ICIE model suggests that targeted external interventions can shift enterprises from a low-level equilibrium to a growth trajectory. The success of waste-based eco-enterprises in Kano (Sule & Wali, 2025) and the positive impact of entrepreneurial innovation in Abuja (Agbaeze et al., 2021) demonstrate that with appropriate institutional support, similar transformations are possible in Lokoja. The existing informal waste collection network, comprising hundreds of enterprises, provides a ready platform for upgrading and formalisation. The waste management crisis in Lokoja is also an entrepreneurial opportunity waiting to be unlocked. Moving from crisis to opportunity requires deliberate, coordinated action to address the binding constraints of finance, technology,

policy, and awareness. The circular economy transition is not merely an environmental necessity but a strategic pathway to job creation, wealth generation, and sustainable urban development.

Based on the findings, the ICIE model, and consistent with the objectives of this study, four strategic recommendations are advanced below. Each recommendation is explicitly linked to specific findings, theoretical propositions, and implementing bodies to ensure actionable guidance for policymakers and development partners.

#### **i: Establish Cluster-Based Waste Industrial Parks**

The finding that individual enterprises cannot afford capital equipment (mean constraint rating of 4.5) directly supports the need for shared infrastructure solutions. Rather than providing individual loans that create debt burdens without guaranteeing equipment utilisation, the Kogi State Government should establish waste industrial parks in strategic locations within Lokoja metropolis where multiple enterprises share baling machines, shredding equipment, washing and pelletizing lines, weighing bridges, and storage facilities. The cluster approach reduces per-enterprise capital requirements from millions of naira to affordable access fees of ₦5,000-10,000 per month. This directly addresses the Innovation-Performance Threshold Theory by enabling enterprises to access mechanical processing without individual capital investment, potentially crossing the innovation threshold identified in this study. Implementing bodies include the Kogi State Government, Kogi State Waste Management Board, and Federal Ministry of Environment. Without this shared infrastructure, the capital constraint will continue to suppress innovation adoption regardless of entrepreneurial capacity or motivation.

#### **ii: Implement Pay-As-You-Throw System with Digital Integration**

The current flat-fee or voluntary payment system provides no economic incentive for waste segregation or formal service subscription, which directly explains the low public awareness (mean 4.2) and the documented knowledge-action gap. A Pay-As-You-

Throw (PAYT) system should be piloted in two Lokoja wards (one high-income, one medium-income) where households pay reduced fees for segregated waste and higher fees for mixed waste. Implementation requires colour-coded bags (green for organic at ₦200/week, blue for recyclable at ₦200/week, black for mixed at ₦500/week) and digital payment integration to reduce leakage. A parallel Digital Waste Marketplace platform should connect waste generators, collectors, aggregators, and recyclers, providing price transparency and reducing information asymmetries that currently depress collector revenues. This recommendation directly addresses the Institutional Trap Thesis by creating structural incentives rather than relying solely on awareness campaigns. Implementing bodies include Lokoja Local Government, Kogi State Waste Management Board, and the Ministry of Environment.

#### **iii: Formalisation Incentive Model with Bundled Benefits**

Current formalisation requirements impose costs (registration fees, taxes, compliance paperwork) without delivering benefits (access to finance, markets, support), creating the Institutional Trap documented theoretically. The proposed Formalisation Incentive Model bundles tangible benefits with registration across three tiers. Tier 1 (Basic registration) provides free training, business advisory services, and a tax waiver for 24 months. Tier 2 (Registered plus certified) provides priority access to waste industrial parks and 50% fee reduction on shared equipment. Tier 3 (Registered, certified, and compliant) provides access to Bank of Industry single-digit loans of ₦500,000 to ₦5 million, government contract preference, and technical assistance. Registration fees should be waived for the first 12 months to encourage uptake, with cost recovery through success fees of 1% of loans accessed. This directly addresses the finding that formal registration positively affects performance ( $\beta = .187$ ) by making formalisation economically rational. Implementing bodies include the Kogi State Enterprise Development Agency, the Ministry of Commerce and Industry, and the Bank of Industry.

#### iv: Sustained Public Awareness with Structural Incentives

Awareness campaigns alone are insufficient to change behaviour, as documented by the knowledge-action gap. The PAYT system from Recommendation 2 provides the necessary structural incentive. Awareness campaigns should therefore focus on explaining and normalising the new system rather than delivering generic environmental messaging. Specific actions include radio jingles in English, Hausa, and Igala explaining the colour-coded bag system; school competition programs with cash prizes for schools achieving the highest segregation rates; a community champions program training 50 local leaders as waste ambassadors; and long-term integration of waste management education into the primary school curriculum. Simultaneously, a waste entrepreneurship training programme should be rolled out through the Kogi State University Innovation and Entrepreneurship Hub, covering basic business management, record-keeping, customer acquisition, and low-cost innovation techniques, including composting and simple baling methods. Training should be free for informal waste collectors and explicitly linked to the formalisation incentive model to ensure uptake translates into registration. Implementing bodies include the Ministry of Environment and Ecological Management, Federal University Lokoja, and the National Orientation Agency. Without structural incentives, awareness will continue to produce short-term interest followed by behavioural regression, as documented in the

qualitative finding that residents "listened, but after one week, they forgot."

#### Limitations and Future Research Directions

This study has several limitations that suggest directions for future research:

First, the cross-sectional design cannot definitively establish causality, despite the instrumental variable approach and temporal separation. A longitudinal study tracking enterprises over 24-36 months would provide stronger evidence for the causal direction from innovation to performance. Second, the study focused only on the Lokoja metropolis. Comparative studies across multiple North Central Nigerian cities (Minna, Makurdi, Ilorin, Jos) would test the generalizability of the ICIE model and the Low-Level Equilibrium Trap thesis. Third, the innovation measurement focused on adoption (whether an innovation is used) rather than intensity (how well it is used) or sophistication (level of technological advancement). Future research should develop multi-dimensional innovation metrics. Fourth, the study did not collect data from waste generators (households and businesses), thereby representing only the supply side of the waste management system. Household-level data on willingness to pay, segregation behaviour, and satisfaction with services would provide a complete systems analysis. Fifth, while this study proposed the ICIE model theoretically, the empirical testing was conducted within a single study. Future research should explicitly test the model's propositions using structural equation modelling with larger, multi-city samples.

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